cians in devising emergency type equipment and methods.

REHEARSALS

Perhaps the most important functions in morale building and training for disaster have been the rehearsals which have been held. Many lessons were learned in connection with rehearsals. The following seem to me to be the most important:

(1) Rehearsals can be used as a morale-building factor. No other part of our defense program within the hospital seemed to stimulate the enthusiasm and support of the personnel. The publishing of bulletins, and the isolated instances of demonstration, failed to create the needed enthusiasm.

(2) It was evident that all employees of the hospital should participate in some way in order that each might feel a part of the functional unit. This was easily made possible by thought on the part of the Rehearsal Committee.

(3) A sufficient number of casualties should be available and, in my opinion, a sufficient number is 15 more casualties than could possibly be handled with the entire staff on duty, and all equipment available. In earlier rehearsals where only a few victims were admitted, most of the staff did not have an opportunity to work actively. Consequently, they went away feeling that there was too much "make-believe." On the contrary, in those rehearsals where everybody worked, and there was much more than could be done, they went away with the feeling that they had actively participated in a real program.

(4) Activation of all departments should be insured by the proper direction on the tags of the victims. An important point which was learned early in the war was the fact that physicians do not need practice in diagnosis since that is their life's work, and they are participating in that type of activity daily in their routine work. It was evident that we needed practice in traffic management and interdepartmental relationships. In order to carry out this idea, all casualties should be tagged with instructions which will direct them to a specific department, so that the work will be evenly distributed and everyone will be busy.

(5) Casualties should be admitted in such order that all departments will start working as early as possible during rehearsal. This was accomplished by first admitting a patient to the x-ray department; secondly, a patient needing a transfusion; thirdly, a woman in labor for the maternity division; fourth, a patient who needed surgical treatment in the operating room; fifth, an hysterical patient admitted to the psychiatric ward; sixth, a child in diabetic coma to the pediatric ward, etc. In this way, there was no idle time during the first half hour of the rehearsal.

(6) It is very desirable to have a specific point at which time all activities will cease regardless of at what stage the department is functioning.

(7) It is very desirable to have a meeting of all those who have participated in the disaster rehearsal. This meeting should not be a post-mortem of the rehearsal, since frequently unrest and dissatisfaction on the part of a few may be contagious and make others discontented. I strongly advise holding such post-mortems in small groups in specific departments. In this way, the surgical division can review its program regarding shock and burns by itself, etc. I believe that the general meeting should be a morale-building meeting, and the time should be given over to two or three speakers who have some interesting message regarding war effort. It is always amazing to see, collected in one auditorium, the number of people who have participated in a rehearsal, as during the rehearsal this group is spread around the hospital so many places that no one realizes the great number who are functioning during the program. The accompanying diagrammatic sketch shows the arrangement of a hospital for the care of the injured that would come from a local catastrophe or bombing.

SUMMARY

We, of California, can be very grateful for the many points we have learned, and the experience we have had since Pearl Harbor. I am sure that the hospitals and their personnel will be better prepared to meet a disaster of enemy action, sabotage or natural forces because of the concentrated thought we have given the subject during the past months.

Clay and Webster Streets.

SHOCK*

ROBERTSON WARD, M. D.
San Francisco

THE best treatment for shock is prevention. The guiding principle should be early recognition of impending or primary shock, and its early treatment, and thus the prevention of secondary shock. Accepting these premises, it is not difficult to realize the importance of early symptoms. British experience indicates that 20 to 30 per cent of air raid casualties suffer from severe injuries and associated shock. If deaths are to be prevented, it is necessary to treat prophylactically all patients suffering from injuries which may produce shock, rather than wait until classical signs develop before therapy is instituted.

PRIMARY SHOCK

Primary shock due to neurogenic and psychogenic influences follows quickly after receipt of trauma and, unless complicated by loss of blood or other shock-producing factors, is of short duration. The characteristic circulatory change is vasodilation. Sweating, relatively warm skin, low-blood pressure, feeble and usually slow pulse and syncope are the characteristic findings. First aid

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* One of several papers in a Symposium on "Emergency Medical Service in Wartime." Papers collected by Henry Gibbons, III.

Generous use of material and text from O.C.D. publication 2212 was made, as per Reference I.

measures are recumbent position, conservation of body heat and relief of pain. If there is not early favorable response to therapy, or if there is considerable blood loss or damage to tissues, secondary shock may ensue, unless appropriate antishock measures are promptly instituted. Because there is no early pathognomonic sign, and because recognition of early or preshock states is difficult as compared with advanced shock, it is imperative to have experienced medical personnel in attendance, and adequate facilities for observation and treatment near the ambulance entrance to all casualty-receiving hospitals. Preventative treatment at this stage is so important, and so much more easily accomplished than in the full-blown stage described below, that the physician should err on the side of over- rather than undertreatment. A history of trauma, with or without external signs of injury, in a casualty with a clammy pale skin and a pulse rate of 100 persistent for several minutes, is presumptive evidence of impending shock and is sufficient indication for the prompt institution of antishock therapy. Casualties suffering burns which involve more than 10 per cent of the body surface should likewise be considered as potential shock candidates and be treated prophylactically.

SECONDARY SHOCK

Secondary shock, caused by tissue damage, is usually later in onset than primary shock, and is likely to develop insidiously an hour or more after injury. Advanced shock is not difficult to recognize. It is characterized by pallor, weakness, fatigue, thirst, cold perspiration, rapid thready pulse, rapid shallow respiration, low-blood pressure and collapsed veins. The mental state of the patient is not a reliable sign of either the presence or severity of shock.

The predominant characteristic of secondary shock is diminution in the effective circulating blood volume, accompanied by compensatory vasoconstriction. This fundamental circulatory disturbance results in decreased cardiac output, diminshed venous return to the heart, inadequate peripheral circulation, and, finally, impaired blood supply to the tissues. Hemoconcentration and progressive diminution in the blood volume occur. If uncorrected, the peripheral arteriolar constriction which served to maintain blood pressure in the presence of a diminshing blood volume, is unable to afford adequate compensation. The peripheral circulation fails, vasodilation ensues, and the blood pressure drops. A fall in blood pressure is therefore a *late* manifestation of shock. Since, due to vasoconstriction, the arterial blood pressure may be normal in the presence of a dangerous reduction in blood volume, *measurement of blood pressure is an inadequate guide to the presence of early shock.* In contrast, blood pressure determinations may be of considerable value in deciding upon the efficacy of therapy, particularly in regard to plasma dosage. Profound physiologic disturbances which are secondary rather than causative factors are acidosis (diminished alkali reserve), oliguria or anuria, and disturbances of various chemical equilibria.

The initial reduction of blood volume in secondary shock may be due either to loss of whole blood (hemorrhage) or to loss of plasma (burned surfaces, injured tissues), or both. Dehydration, fatigue, pain, fear, and exposure to cold contribute further to its development. During the early phases of shock due to hemorrhage, initial dilution of the blood by fluid drawn into the circulation from the tissues occurs, unless dehydration is present. In inadequately-treated shock, especially when hemorrhage has occurred, hemoconcentration due to plasma loss is a relatively late characteristic, representing loss of plasma to the tissues in excess of the loss of whole blood. If adequate therapy is not instituted promptly, such a loss of plasma will lead to irreversible shock much more readily than will an equal loss of whole blood.

When the loss of whole blood predominates over the loss of plasma in a normally-hydrated individual, hemoconcentration may not occur, even though shock is advanced. In such instances hemoglobin and hematocrit determinations will merely show evidence of anemia.

However, low hemoglobin and hematocrit findings, coupled with a low plasma protein level, mean acute blood loss, and indicate the need for prompt plasma therapy to combat shock, followed by whole blood transfusion, if the blood loss has been severe.

PREVENTION OF SHOCK

Since our primary object is the prevention of shock, there should be some emphasis placed upon the handling of casualties up to the time of their arrival at the hospital. Definitive treatment for the varied types of injuries will be covered in other sections of this series, but much can be done to lessen this work by the physician in charge of first aid. This is especially true in shock prevention

Control of Hemorrhage:

Hemostasis should be accomplished, if possible, by elevation of the extremity, the application of pressure dressings, the use of pressure over the artery proximal to the wound, the insertion of sterile gauze packs or even ligation of the vessel if facilities are available. Only when these measures have failed should a tourniquet be applied. British experience has indicated that tourniquets are rarely necessary in the first aid treatment of air raid casualties.

If a tourniquet is used the following precautions are necessary: 1. Both venous and arterial circulation must be occluded. 2. TK should be marked on the casualty's forehead and the time of application noted on casualty identification tag attached to the wrist at the site of the incident. 3. No bandages should cover or hide the tourniquet. At the receiving hospital, loss of plasma into damaged tissue should be prevented by substituting pressure dressing for tourniquet or amputating before its removal.

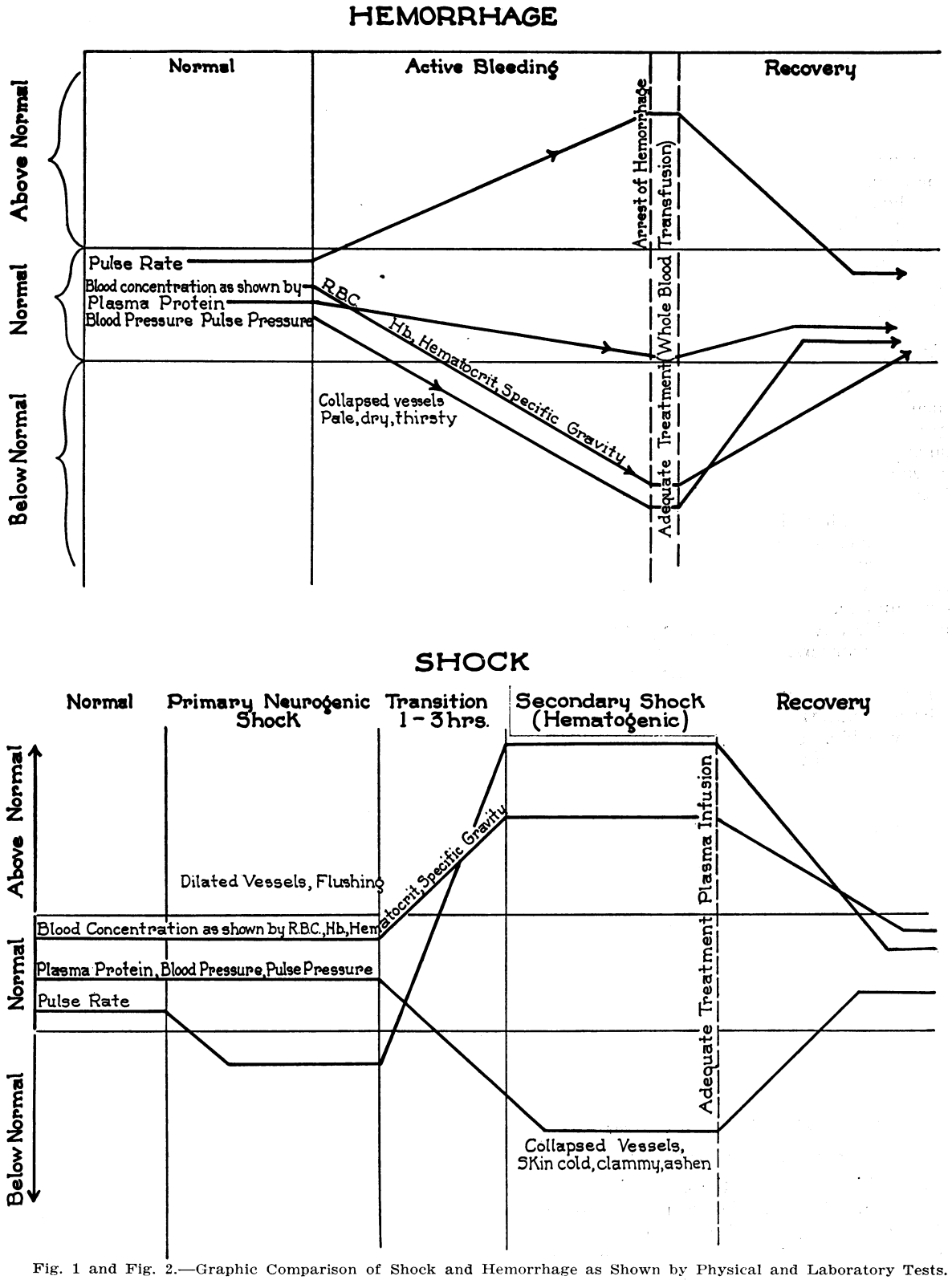

Fig. 1 and Fig. 2.—Graphic Comparison of Shock and Hemorrhage as Shown by Physical and Laboratory Tests.

Relief of Pain:

Since pain is one of the prime factors in producing shock, its early relief by hypodermic administration of ¼ to ½ grain of morphine is indicated. This should be almost routine except that in restlessness and pain due to intracranial injuries sodium phenobarbital or sodium amytal are indicated in adequate dosage. In many cases morphine should be given before rescue from fallen timbers is begun. The time and dose should always be noted on the identification slip.

Immobilization of Fractures:

Splinting of fractures results in minimizing two important factors in the production of shock-soft tissue damage and pain. Every effort should be made to splint fractures before transportation, and the experience in England has shown that traction splints are seldom necessary or advisable for transportation over city streets to the receiving hospital. Well-padded splints fixed firmly above and below, but not over the fracture site, are the best and most easily applied means of immobilization. These should include joints on either side of the fracture. Folded newspapers, blankets or pillows are often satisfactory.

Care of Wounds:

The care and promptness of the first aid treatment of open wounds (including burns) is of great importance in determining the likelihood of subsequent severe infection. It is better to leave a wound undressed than to give first aid carelessly.

As a result of British experience with the first aid treatment of air raid casualties, several points may be emphasized. Most air raid victims are extremely dirty and begrimed, their wounds are contaminated with dust, dirt, and débris, making impossible any attempt at adequate cleansing by first aid workers. Emphasis should be placed on the rapid removal of casualties from the site of disaster to casualty-receiving stations or hospitals, where facilities necessary for proper treatment are available. Unless a wound is bleeding profusely, it should be left alone except for the application of a sterile dressing to prevent further contamination during transportation to a place where aseptic technique can be observed. The chief exception to this rule is in the care of a sucking wound of the chest where immediate sealing by the best available means should be carried out. A moist dressing held in place by pad snugly strapped to the chest by adhesive serves well. Sterile sulfa powder should be sprinkled in the wound before application of sterile dressings. No strong antiseptics should be used.

Further contamination of wounds by droplet infection should be avoided by those giving first aid.

Maintainence of Body Temperature:

Since a definite relationship exists between the loss of body heat and the onset of shock, every effort should be made to prevent or correct chilling. Blankets under and over the patient, preliminary dressing in a warm place, removal of wet clothing and warming devices in the ambulance or other transportation are the safest and most easily-applied measures. The use of external heat must be cautiously applied because of the danger of burns and the danger of overheating. The latter danger has been emphasized by British experience (2) where it has been suggested that further depletion of an already reduced volume of circulating fluid may be brought about by peripheral vasodilation.

Shock Position:

In general a positon with the head slightly below the horizontal is advisable to maintain circulation to the brain, but this procedure must be avoided in head injuries and where uncontrolled bleeding of nasal and other head and neck wounds is present.

TREATMENT OF SHOCK

Restoration of the circulating fluid volume to normal is the prime and most important therapeutic measure, not only for prevention of, but for treatment of established secondary or traumatic shock. Rapid and lasting accomplishment of this restoration of blood volume is best attained by intravenous infusion of adequate amounts of whole blood, blood plasma or serum. There is no accurate way in which to predict the proper dosage. The all-important point is to give blood plasma or serum early, and to give it in sufficient quantity to produce the desired effect. Restoration of normal blood volume is the aim. The quantity must be sufficient to accomplish this. Any quantity less than this means that the patient has been inadequately treated.

The two rules which follow are of value in estimating the amount of plasma necessary for treatment, but final dosage is based upon *clinical* results: (1) give 100 c.c. of plasma for each point the hematocrit reading is above the normal of 45, and (2) where hemoglobin determinations are used, give 40 c.c. of plasma for every point the hemoglobin reading exceeds 100.

The decision as to the use of whole blood or plasma should be made upon whether hemorrhage has accompanied or has been contributory to the shock. Although the establishment of blood banks in many communities has lessened the difficulty of obtaining suitable whole blood, the trend of emergency treatment is toward blood derivatives such as plasma, serum and serum albumen for shock because of the ease of transportation, storage and administration. Their chief virtue lies in the fact that the protein content restores blood plasma volume physiologically, while at the same time they can be given more rapidly than whole blood and without the necessity of typing or cross-matching.

The rare air raid casualty that dies of hemorrhage is usually the one that succumbs to acute blood loss before medical aid is available. So long as normal blood volume is maintained by plasma infusions, the transfusion of whole blood can almost be relegated to a nonemergency procedure to be used for the replenishment of erythrocytes in the cases of prolonged bleeding or posttraumatic anemia.

SERUM AND PLASMA

Since whole blood is rarely indicated in air raid emergencies and since serum albumen, bovine and other preparations are still in the experimental stage, the following discussion will be devoted to serum and plasma.

There is little difference between the relative virtues of plasma and serum, provided both have been properly prepared (i.e., sterile and free from pyrogens).

Plasma is suitable for use without preliminary laboratory typing and compatiblity tests, and is free from the danger of severe reaction attendant on the use of whole blood. It is not necessary to warm plasma before administration, and it can be given as rapidly as the needs of the recipient warrant. It must be filtered, however, while being administered.

Plasma is currently stored in one of three ways: namely, as liquid plasma, frozen plasma or dried plasma and is prepared and administered as shown below. Liquid plasma is the basic form and may be stored for one year at room temperature provided enough 50 per cent dextrose has been added to make a 5 per cent final concentration of dextrose.

ADMINISTRATION OF PLASMA

As a general rule, plasma should be given by the intravenous route, as are glucose and saline solutions. A filter is always used in the intravenous set-up. There are many times, however, when, because of extensive burns or collapse of the veins due to profound shock, the intravenous administration is difficult or impossible. In these instances the most effective and rapid method of reaching the general circulation is by introduction of a needle into the bone marrow of the sternum in adults or the tibia or femur in children. The technique of this procedure is simple. The skin is prepared in the usual manner, then 2 or 3 c.c. of 1 per cent procain are injected in skin and periosteum, a short, styletted 10-to-20 gauge, needle is introduced at an angle of 45 degrees to the skin surface with a rotating or boring motion until a sudden decreased resistance is noted. This indicates that the needle has entered the marrow space. The stylet is removed, a syringe applied and marrow fluid aspirated. The intravenous set is attached to the needle and either rapid or slow infusion is carried out.

PREPARATION OF PLASMA FOR USE

1. Liquid plasma should be kept at a temperature of 55° to 100° F. and is available for immediate use.

2. Frozen plasma must be properly thawed before administration; otherwise, considerable precipitation of fibrin will occur. The precipitation of fibrin does not render plasma toxic, but makes it extremely difficult to administer. In order to prevent this, it is necessary to thaw the plasma rapidly in a constant temperature water bath at 98.6° F. (37° C.). Thawing is usually complete within 20 to 30 minutes. The speed of thawing may be increased by providing for constant circulation of water in the water bath. In an emergency, it is possible to thaw plasma adequately in tubs and basins, using the available supply of hot and cold water providing the temperature is maintained with a thermometer at 37° to 40° C. If controlled temperature hydrotherapy baths are available, they will serve ideally for the thawing of frozen plasma.

3. Instructions of reconstituting dried plasma are furnished with each individual package.

4. Plasma or blood should not be artificially heated except by means of a 98.6° F. (37° C.) water bath.

5. Administration of blood or plasma at room or even at ordinary ice-box temperature 35° to 42° F. (2° to 6° C.) is not harmful.

SURGICAL TREATMENT OF CASUALTIES EXPOSED TO SHOCK-PRODUCING INJURIES

(a) *Time of Operation:*

Early operation on casualties is indicated for many reasons. This is particularly true in those instances in which bleeding cannot be stopped by simple means, and in which there are penetrating wounds of hollow viscera, such as the intestinal tract. The length of time separating the injury and operation is an important factor in determining how wounds should be treated, and whether shock and other complications will develop. In general, it may be stated that the mortality will vary directly with the time intervening between the major injury and operation. *Plasma or blood should be given during and after the operation to prevent relapse into the shock state.*

(b) *Anesthesia:*

Since only in the most exceptional circumstances should any operative procedures be undertaken while a patient is in shock, it will rarely be necessary to use anesthesia in shock cases. There are three main points to be borne in mind before administering an anesthetic agent to a patient who has suffered shock: 1. Deep anesthesia in any form is contraindicated. However, it must be remembered that inadequate anesthesia may itself result in shock. 2. The amount of anesthetic agent that will produce light anesthesia in normal patients may be an overdose for such patients. 3. Respiratory function must not be embarrassed by undue stimulation, interference with the airway, or inadequate oxygenation.

The ideal anesthetic to be used in these patients has not been found. Problems which influence the choice of anesthetics are the general condition of the patient, the type of wound, the part of the body involved, and the length of time between injury and operation. In addition to strictly physiologic factors, other considerations are also important in choosing anesthetics for emergency purposes. These include bulk, weight, transportability, explosibility, and fire hazard.

Air raid casualties who are buried under débris require special consideration. They are likely to be in shock, and often suffer from dehydration. Extrication from wreckage may in some instances be possible only by amputation of a limb. The type of anesthesia administered to such casualties will depend on the part of the anatomy in reach, the choice usually lying between open ether, intravenous morphine, or barbiturates. Patients with facial injuries likewise present special anes-

thesia problems. Under such emergency conditions intravenous barbiturates may be useful when there is no danger of inhaling blood and when veins are accessible. In some instances endoctracheal anesthesia may be necessary.

Nitrous oxide-oxygen anesthesia gained considerable popularity in the last war, due in large part to the observation that animals anesthetized with gas-oxygen mixtures were more resistant to histamine shock than those anesthetized with ether.

Cyclopropane is a satisfactory anesthetic agent for casualties who have suffered from shock, because it can be administered with high concentrations of oxygen and with minimum toxic effects. The greatest drawback to its use is its high explosibility. As with other gaseous anesthetics, there is difficulty in transportation because of cylinder bulk. *Ethylene* presents no significant advantages over cyclopropane.

Ether is probably the safest of all inhalation anesthetic agents, especially when combined with oxygen. It appears likely that its harmful effects, except for prolonged operative procedures, have been overemphasized.

Spinal anesthesia is ideal for operations on the lower extremities and lower abdomen in patients *in whom the blood volume and blood pressure are not significantly depressed.* It should *never* be used on a patient who is in shock or has recently recovered from shock.

Recent advances in the use of *intravenous anesthetic* agents indicate that they may be suitable for brief anesthesia in patients suffering from traumatic injuries. A number of short-acting barbiturates are available and, if given in small amounts repeatedly, they may be of value under special emergency circumstances. The use of these drugs is, however, not without danger. One should avoid large doses of such agents in casualties in poor condition, since they are capable of causing histotoxic anoxia. It is essential that an attendant be present at all times in order to make sure that an open airway is maintained and that a high concentration of oxygen is supplied in the inspired air. Intravenous agents have the advantages of small bulk and weight, and freedom from fire and explosion hazards.

Local or regional block anesthesia is the best for operations on patients in shock and should be used whenever possible.

From the anesthesia viewpoint, all hospitals treating casualties can function quite satisfactorily with a few relatively simple substances; namely, procaine, and intravenous barbiturates such as pentothal, and oxygen-ether.

(c) *Penetrating Wounds:*

Penetrating wounds require special consideration because improper treatment of them is likely to result in shock. The care of these wounds is covered in another paper of this symposium.

(d) *Postoperative Care:*

The postoperative care of a shocked patient is similar in many respects to his preoperative care and is as important. *After operation, careful observation and treatment of the patient are necessary to prevent recurring shock.*

SUMMARY OF SHOCK TREATMENT

1. Prevent its development.
2. Stop bleeding.
3. Relieve pain.
4. Avoid continued tissue damage by such measures as splinting of fractures, et cetera.
5. Maintain body temperature—prevent chilling—do not overheat.
6. Place in shock position, unless contraindicated.
7. Give sufficient whole blood, plasma, or serum as soon as possible.
8. Administer warm fluids as indicated.
9. Choose an anesthetic agent which will not aggravate the condition.
10. Do necessary surgery as quickly, and with as little tissue damage, as possible, but only after shock has been controlled.
11. Carefully observe the shocked patient postoperatively. Do not let him relapse into shock. Remember that the primary disturbance in shock is diminution in the effective circulating blood volume. Treat it by intravenous administration of blood, plasma, or serum.

384 Post Street.

REFERENCES

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3. Moon, V. L.: Shock, Lea & Febiger, 1942.
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(C.P.S. Continued from Page 208)

for C.P.S. to operate its professional program free-handedly. It would seem, therefore, that when, as and if government participates widely in the provision of medical service for the population or parts thereof, C.P.S. and similar organizations could well be used as the instruments to furnish the professional services required under the programs.

At the conclusion of the Secretary's testimony, Senator Pepper stated that C.P.S. will be the object of further study by his committee.

Dr. Larsen and the Secretary left Washington feeling that the attitude of Senator Pepper and his committee is one of deep interest in the extension of medical care and the methods by which it may be accomplished, with due consideration for the rights and customs of the various groups concerned.*

153 Kearny Street (8)

If you have genius, industry will improve it; if you have none, industry will supply its place.—*Sir Joshua Reynolds.*

* Mr. Albee Slade discussed a general health program and California Physicians' Service, but Secretary Kelly and Medical Director Larsen of C.P.S. had to leave before Mr. Slade made his remarks.